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Millwork West Site Improvements  
Libby, Montana

**DRAFT**  
**TECHNICAL SPECIFICATIONS**

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Prepared by

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SECTION 01010  
SUMMARY OF WORK

PART 1 GENERAL

1 01 LOCATION OF WORK

- A The work of this contract is located in the City of Libby, Montana The two existing Millwork West Buildings are located on Highway 2

1 02 SCOPE OF WORK

- A Furnish all labor, materials, equipment and incidentals required to install asphalt paving in Building No 1 and a reinforced concrete floor and restroom in Building No 2 complete as shown on the Drawings and as specified herein
- B The work is being performed as part of the U S EPA asbestos removal and restoration project in Libby, Montana
- C The work includes providing underground electric service and City water service to a proposed restroom in Building No 2 and a septic tank, submersible pump and discharge piping to an existing permitted septic tank and leaching area also located on the property
- D The Work includes, but is not necessarily limited to the following
- 1 Providing all excavation and backfilling for electric service, water service, septic tank, and sewage discharge piping
  - 2 Subgrade preparation and installation of a asphalt pavement covering approximately 50% of the Building No 1 floor area, full reinforced concrete floor in Building No 2 and one restroom in Building No 2
  - 3 All necessary electrical, HVAC, carpentry, painting, plumbing and all other work required to complete the work described on the Drawings and in the specifications
- E These Drawings and accompanying specifications have been prepared for the Government's use in providing a general description of the work to be completed by the Government's removal contractor at Building No 1 and Building No 2 on Highway 2 in Libby Montana
- F The work described in the Drawings and specifications will be constructed in two wood frame metal clad buildings originally intended to serve as a temporary location for the Millwork West lumber and building materials business
- G The work described on the Drawings and in the specifications is not intended to be publicly bid
- H The Drawings and specifications are intended to be provided to the Government's removal contractor for cost estimates, construction scheduling, obtaining local subcontractors

appropriately licensed to perform specialty construction (plumber, electrician, etc ), obtaining necessary local permits (restroom permit) and completing the work

- I The Drawings and specifications are intended to provide a general description of the work to be performed The Government's removal contractor is required to verify all dimensions prior to starting the work
- J No property line or topographical surveys were available to reference for preparation of the Drawings
- K No investigations have been made with respect to the current use or potential use of the existing buildings
- L Evaluation of the existing buildings with respect to structural integrity, Building Code compliance, existing condition were not included in the design scope of work
- M CDM's scope of work for existing Building No 2 was limited to design of a reinforced concrete slab to be installed by the Government s removal contractor, design of a single unisex, handicapped accessible restroom meeting the requirements of the ANSI Accessibility Code, 1998 edition, restroom water service, restroom electric service and pumped discharge of all waste from the proposed restroom to an existing permitted septic tank located on the property approximately 300 ft from Building No 2
- N CDM's scope of work for existing Building No 1 was limited to design of asphalt pavement to be installed by the Government's removal contractor over approximately 50% of the interior floor area

#### 1 03 WORK SEQUENCE

- A The Contractor shall coordinate the scheduling of all work with the Government and Owners of Millwork West All work shall be completed in 2002
- B Work in Building No 1 and Building No 2 shall not be performed simultaneously Work will not begin in one building until all work is completed in the other building Contractor shall coordinate order of work with the Government and Owners of Millwork West
- C No work shall begin on Building No 1 or Building No 2 until work by others at the new Planer Building is complete
- D Contractor shall conduct all work in a manner so as not to interfere with the daily operation of the Millwork West business

#### 1 04 CONTRACTOR'S USE OF PREMISES

- A Contractor shall coordinate use of the designated areas on the premises for the performance of the work with the Government and Owners of Millwork West Utility companies shall also have complete access to the property for water and electric service
- B Only areas approved by the Government and Owners of Millwork West shall be used for storage of materials, equipment, etc Existing utilities, structures and stored materials owned by

Millwork West shall not be entered upon or in any way disturbed by the Government's removal contractor and any of its' subcontractors in the performance of this work

- C Contractor shall assume full responsibility for safety and security of all his/her and his/her subcontractors materials and equipment stored on the site
- D If directed by the Government, move any stored items that interfere with operations of the Owners of Millwork West
- E Obtain and pay for use of additional storage or work areas if needed to perform the Work

1 05 OWNERS OF MILLWORK WEST OCCUPANCY

- A Owners of Millwork West will occupy the improved premises following completion of the work and approval from the Government for the conduct of normal business operations Coordinate all construction operations with the Government and Owners of Millwork West to minimize conflict and to facilitate usage

END OF SECTION

## SECTION 03301

### CONCRETE AND REINFORCING STEEL

#### PART 1 GENERAL

##### 1 01 SCOPE OF WORK

- A Furnish all labor, materials, equipment and incidentals required and install all concrete work complete as shown on the Drawings and as specified herein

##### 1 02 RELATED WORK

- A Earthwork is included in Division 2

##### 1 03 SUBMITTALS

- A Submit in accordance with Section 01300 shop drawings and product data Submittals shall include the following

- 1 Concrete mix for each formulation of concrete proposed for use including constituent quantities per cubic yard, water cementitious ratio type and manufacturer of cement
- 2 Placing drawings and bar bending details in conformity with the recommendations of ACI 315
- 3 Technical data on all materials and components
- 4 Material Safety Data Sheets (MSDS) for all concrete admixtures and curing agents

- B Test Reports

- 1 Sieve analysis of fine and coarse aggregates
- 2 Concrete mix for each formulation of concrete proposed for use including constituent quantities per cubic yard water cementitious ratio, type and manufacturer of cement, and either a or b below
  - a Standard deviation data for each proposed concrete mix based on statistical records
  - b Water cementitious ratio curve for each proposed concrete mix based on laboratory tests Give average cylinder strength test results at 28 days for laboratory concrete mix designs Provide results of 7 and 14 day tests if available

- C Certifications

- 1 Certify admixtures used in the same concrete mix are compatible with each other and the aggregates

##### 1 04 REFERENCE STANDARDS

A American Society for Testing and Materials (ASTM)

- 1 ASTM A82 Standard Specification for Steel Wire, Plain, for Concrete Reinforcement
- 2 ASTM A185 Standard Specification for Steel Welded Wire Fabric, Plain for Concrete Reinforcement
- 3 ASTM A615 Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
- 4 ASTM C31 - Standard Practice for Making and Curing Concrete Test Specimens in the Field
- 5 ASTM C33 - Standard Specification for Concrete Aggregates
- 6 ASTM C94 - Standard Specification for Ready-Mixed Concrete
- 7 ASTM C143 - Standard Test Method for Slump of Hydraulic Cement Concrete
- 8 ASTM C150 - Standard Specification for Portland Cement
- 9 ASTM C173 - Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method
- 10 ASTM C231 - Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method
- 11 ASTM C260 - Standard Specification for Air Entraining Admixtures for Concrete
- 12 ASTM C494 - Standard Specification for Chemical Admixtures for Concrete
- 13 ASTM C920 - Standard Specification for Elastomeric Joint Sealants
- 14 ASTM D1752 - Standard Specification for Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction

B American Concrete Institute (ACI)

- 1 ACI 211.1 - Standard Practice for Selecting Proportions for Normal, Heavyweight and Mass Concrete
- 2 ACI 301 Standard Specification for Structural Concrete
- 3 ACI 305R Hot Weather Concreting
- 4 ACI 306R - Cold Weather Concreting
- 5 ACI 315 - Details and Detailing of Concrete Reinforcement
- 6 ACI 318 - Building Code Requirements for Structural Concrete

C Concrete Reinforcing Steel Institute (CRSI)

1 MSP - Manual of Standard Practice

D Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply

## 1 05 QUALITY ASSURANCE

A If, during the progress of the work, it is impossible to secure concrete of the required workability and strength with the materials being furnished, the Engineer may order such changes in proportions or materials, or both, as may be necessary to secure the desired properties. All changes so ordered shall be made at the Contractor's expense.

B Reinforced concrete shall comply with ACI 318

C All testing and inspection services required, unless otherwise specified, shall be provided and paid for by the Owner. Testing necessary to establish the concrete mixes shall be performed by and at the expense of the Contractor. Methods of testing shall comply with the latest applicable ASTM standards.

## 1 06 DELIVERY, STORAGE AND HANDLING

A Reinforcing steel shall be shipped and stored with bars of the same size and shape fastened in bundles with durable tags, marked in a legible manner with waterproof markings showing the same designations as shown on the submitted placing drawings. Reinforcing steel shall be free from mill scale, loose rust, dirt, grease, or other foreign matter. Store off the ground and protect from moisture, dirt, oil, or other injurious contaminants.

B Products shall be stored in conformity with the manufacturer's recommendations.

C Sand, aggregates and cement shall be stored or stockpiled in conformity with the recommendations of ACI 301.

## PART 2 PRODUCTS

### 2 01 GENERAL

A The use of manufacturer's name and model or catalog number is for the purpose of establishing the standard of quality and general configuration desired.

B Like items of materials shall be the end products of one manufacturer in order to provide standardization for appearance, maintenance and manufacturer's service.

C Materials shall comply with this Section and any applicable State or local requirements.

### 2 02 MATERIALS

A Cement shall be domestic portland cement conforming to ASTM C150. The allowable types of cement for each concrete class are shown in Table 1. Air entraining cements shall not be used.

- B Fine aggregate shall be washed inert natural sand conforming to the requirements of ASTM C33
- C Coarse aggregate shall be a well graded crushed stone or washed gravel conforming to the requirements of ASTM C33, size 67 Limits of Deleterious Substances and Physical Property Requirements shall be as recommended for severe weathering regions
- D Water shall be potable, clean and free from injurious amounts of oils acids, alkalis, organic matter, or other deleterious substances
- E Concrete admixtures shall be free of chlorides and alkalis (except for those attributable to water) When it is required to use more than one admixture in a concrete mix, the admixtures shall be from the same manufacturer Admixtures shall be compatible with the concrete mix including other admixtures [and shall be suitable for use in contact with potable water after 30 days of concrete curing]
  - 1 Air entraining admixture shall comply with ASTM C260 Proportioning and mixing shall be in accordance with manufacturer's recommendations
  - 2 Water reducing admixture shall comply with ASTM C494, Type A Proportioning and mixing shall be in accordance with manufacturer's recommendations
  - 3 Admixtures causing retarded or accelerated setting of concrete shall not be used without written approval from the Engineer When allowed, the admixtures shall be retarding or accelerating water reducing admixtures
- F Reinforcing steel bars shall be deformed, intermediate grade, steel conforming to ASTM A615 Grade 60
- H Welded steel wire fabric shall conform to ASTM A185
- I Tie wires for reinforcing steel shall be 16 gauge or heavier, black annealed wire
- J Precast concrete block bar supports shall conform to CRSI - Manual of Standard Practice (MSP) for Precast Concrete Bar Supports
- J Premolded joint filler shall be self-expanding cork conforming to ASTM D1752, Type III The thickness shall be 3/4-in unless shown otherwise on the Drawings
- J Sealant shall be a traffic-grade, polyurethane, elastomeric sealant conforming to ASTM C920 and shall be Sikaflex 2c NS TG by Sika Corporation, Lyndhurst NJ, or equal

## 2 03 MIXES

- A Select proportions of ingredients to meet the design strength and materials limits specified in Table 1 and to produce concrete having proper placability, durability strength, appearance and other required properties Proportion ingredients to produce a homogenous mixture which will readily work into corners and angles of forms and around reinforcement without permitting materials to segregate or allowing excessive free water to collect on the surface



- B The design of each mix shall be based on standard deviation data of prior mixes with essentially the same proportions of the same constituents or, if not available be developed by independent testing laboratory acceptable to the Engineer engaged by and at the expense of the Contractor. Acceptance of mixes based on standard deviation shall be based on the modification factors for standard deviation tests contained in ACI 318. Acceptance of mixes based on laboratory tests shall be based on strengths greater than the specified design strengths specified in Table 1. The water content of the concrete mixes to be used as determined from the curve, shall correspond to strengths 16 percent greater than the specified design strength. The resulting mix shall not conflict with the limiting values for maximum water cementitious ratio and net minimum cementitious content as specified in Table 1.
- C Compression Tests Provide testing of the proposed concrete mix or mixes to demonstrate compliance with the compression strength requirements in conformity with the above paragraph.
- D Entrained air, as measured by ASTM C231, shall be as shown in Table 1.
- E Slump of the concrete as measured by ASTM C143, shall be as shown in Table 1.
- F Proportion admixtures according to the manufacturer's recommendations. Two or more admixtures specified may be used in the same mix provided that the admixtures in combination retain full efficiency and have no deleterious effect on the concrete or on the properties of each other.

TABLE 1

Class	Design Strength (1)	Cement ASTM C150	Cement Content (2)	W/C (3)	WR (4)	Slump Range Inches
D	4000	Type II	560	0.44 max	Yes	3-5

All concrete classes shall have 3.5 to 5 percent air entrainment.

#### NOTES

- (1) Minimum compressive strength at 28 day  
 (2) Minimum cement content in lbs/cu yd  
 (3) W/C is Water Cement ratio  
 (4) WR is water reducing admixture

#### 2.04 MEASURING, BATCHING, MIXING AND TRANSPORTING CONCRETE

- A Measuring, batching, mixing and transporting concrete shall conform to ASTM C94 and the requirements herein, or as otherwise approved in writing by the Engineer.
- B Ready-mixed concrete, whether produced by a concrete supplier or the Contractor shall conform to the requirements above. No hand mixing will be permitted.

- C Admixtures shall be dispensed into the batch in conformity with the recommendations of the manufacturer of the admixtures
- D Concrete shall be mixed until there is uniform distribution of the materials and shall be discharged completely before the mixer is recharged. The mixer shall be rotated at a speed recommended by the mixer manufacturer and mixing shall be continued for at least 1-1/2 minutes after all the materials are in the mixer. Concrete shall be placed within 1-1/2 hours of the time at which water was first added, otherwise it shall be rejected. Concrete which has been remixed or retempered, or to which an excess amount of water has been added, shall also be rejected

## 2 05 FORMS

- A Forms shall be free from roughness and imperfections, substantially watertight and adequately braced and tied to prevent motion when concrete is placed. No wooden spreaders will be allowed in the concrete
- B Wire ties will not be allowed. Metal ties or anchorages which are necessary within the forms shall be so constructed that the metal work can be removed for a depth of at least 1-in from the surface of the concrete without injury to such surface by spalling or otherwise. Forms shall be thoroughly cleaned before using and shall be treated with oil, or other approved material
- C All exposed edges of the finished concrete shall be chamfered 3/4 in

## PART 3 EXECUTION

### 3 01 REINFORCING STEEL

- A Reinforcing steel shall be accurately fabricated to the dimensions shown. Bars shall be bent around a revolving collar having a diameter of not less than that recommended in ACI 318. All bars shall be bent cold
- B Unless otherwise shown, splices in reinforcing steel shall be lapped in conformity with ACI 318 but not less than 24 diameters. All bar splices shall be staggered wherever possible. When splicing bars of different diameters, the length of lap is based on the larger bar
- C Splices in welded wire fabric shall be lapped not less than 1-1/2 courses or 12-in whichever is greater. Wire fabric splices shall be tied together with wire ties spaced no more than 24-in on center
- D Before being placed in position, reinforcement shall be thoroughly cleaned of loose mill and rust scale, dirt and other coatings, including ice, that reduce or destroy bond. Where there is a delay in depositing concrete after the reinforcement is in place. Bars shall be reinspected and cleaned when necessary
- E Reinforcement which is to be exposed for a considerable length of time after being placed shall be given a heavy coat of cement grout
- F In no case shall any reinforcing steel be covered with concrete until the amount and position of the reinforcements have been checked and permission given to proceed by the Engineer

### 3 02 INSPECTION AND COORDINATION

- A The batching, mixing, transporting, placing and curing of concrete shall be subject to the inspection of the Engineer at all times. The Contractor shall advise the Engineer of his/her readiness to proceed at least 24 hours prior to each concrete placement. The Engineer will inspect the preparations for concreting including the preparation of previously placed concrete, the reinforcing steel, and the alignment, cleanliness and tightness of formwork. No placement shall be made without the inspection and acceptance of the Engineer.

### 3 03 CONCRETE APPEARANCE

- A Concrete mix showing either poor cohesion or poor coating of the coarse aggregate with paste shall be remixed. If this does not correct the condition, the concrete shall be rejected.
- B Concrete for the work shall provide a homogeneous structure which, when hardened, will have the required strength, durability and appearance. Mixtures and workmanship shall be such that concrete surfaces, when exposed, will require no finishing. When concrete surfaces are stripped, the concrete when viewed in good lighting from 10-ft away shall be pleasing in appearance and at 20-ft shall show no visible defects.

### 3 04 PLACING AND COMPACTING

- A No concrete shall be placed until forms, condition of subgrade and method of placement have been approved by the Engineer. Before depositing concrete, all debris, foreign matter, dirt and water shall be removed from the forms. The contact surface between concrete previously placed and new concrete shall be cleaned and brushed with cement paste. Concrete, except as indicated on the Drawings, shall not be placed in water or submerged within 24 hours after placing, nor shall running water be permitted to flow over the surface of fresh concrete within 4 days after its placing.
- B Deposit concrete as near its final position as possible to avoid segregation due to rehandling or flowing. Pumping of concrete will be permitted when an approved design mix and aggregate sizes suitable for pumping, are used. Do not deposit concrete which has partially hardened or has been contaminated by foreign materials. If the section cannot be placed continuously, place construction joints as specified or as approved. Place concrete for walls using tremie tubes in 12 to 24-in lifts, keeping the surface horizontal. Do not drop concrete more than 4-ft.
- C High frequency mechanical vibrators shall be used to the extent necessary to obtain proper consolidation of the concrete, but not to move or transport concrete in the forms. Care shall be taken to avoid segregation of aggregates by excess vibration. Vibration shall continue until the frequency returns to normal, trapped air ceases to rise and the surface appears liquefied, flattened and glistening. Concrete adjacent to forms and around pipe stubs shall be carefully spaded or rodded.

### 3 05 CURING AND PROTECTION

- A Protect all concrete work against injury from the elements and defacements of any nature during construction operations.
- B All concrete shall be cured in conformity with ACI 301. Concrete that is to be used for the containment of water shall be water cured. Water curing shall be by ponding, by continuous

sprinkling or by covering with continuously saturated burlap. Other concrete shall be cured by either water curing, sheet material curing or liquid membrane curing compound except that liquid membrane curing compound shall not be used on any concrete surface where additional concrete is to be placed or where the concrete surface is to be coated or painted.

- C Finished surfaces and slabs shall be protected from the direct rays of the sun to prevent checking and crazing.
- D Concrete placed during cold weather shall be batched, delivered, placed, cured and protected in compliance with the recommendations of ACI 306R. Salt, manure or other chemicals shall not be used for cold weather protection.
- E Concrete placed during hot weather, shall be batched, delivered, placed, cured and protected in compliance with the recommendations of ACI 305R. The temperature of the concrete shall be such that it will cause no difficulties from loss of slump, flash set or cold joints. Immediately cover plastic concrete with sheet material during hot weather.

### 3.06 FIELD TESTS

- A Sets of three field control cylinder specimens will be taken by the Engineer during the progress of the work, in compliance with ASTM C31. The number of sets of concrete test cylinders taken of each class of concrete placed each day shall not be less than one set, nor less than one set for each 150 cu yds of concrete nor less than one set for each 5,000 sq ft of surface area for slabs or walls. One cylinder shall be broken at 7 days and two cylinders shall be broken and their strengths averaged at 28 days. When the average 28 day compressive strength of the cylinders in any set falls below the specified compressive strength or below proportional minimum 7 day strengths (where proper relation between 7 and 28 day strengths have been established by tests), the Engineer may reject the concrete represented by the set of cylinders may require modification of the concrete and/or require modification of the proportions, water content or temperature conditions of the design mix to achieve the required strengths.
- B Cooperate in the making of tests by allowing free access to the work for the selection of samples, providing an insulated closed curing box for specimens affording protection to the specimens against injury or loss through his/her operations and furnishing material and labor required for the purpose of taking concrete cylinder samples. All shipping of specimens will be paid for by the Owner.
- C Slump tests will be made in the field by the Engineer in conformity with ASTM C143.
- D Tests for air content shall be made in compliance with either the pressure method complying with ASTM C231 or by the volumetric method complying with ASTM C173.

### 3.07 STRIPPING AND FINISHING CONCRETE

- A Forms shall not be stripped before the concrete has attained a strength of at least 30 percent of the specified design strength unless otherwise approved by the Engineer. This is equivalent to approximately "100 day-degrees" of moist curing.
- B Care shall be exercised to prevent damaging edges or obliterating the lines of chamfers, rustications or corners when removing the forms or doing any other work adjacent thereto.

- C Clean all exposed concrete surfaces and adjoining work stained by leakage of concrete, to the satisfaction of the Engineer

- D As soon as forms have been stripped, form ties, if employed, shall be removed and the recess filled to insure complete watertightness. Any defects in the surface of the walls shall be chipped out and repaired in a workmanlike manner. Defective concrete where it occurs shall be cut to a minimum depth of 1-in, thoroughly roughened and neat cement brushed in. The hole shall then be filled with mortar in the proportion of 1 part cement and 2 1/2 parts sand with a minimum of water. Mortar for filling form tie recesses shall be mixed to a slightly damp consistency (just short of "balling"), pressed into the recess until dense, and troweled smooth. Mortar in larger patches shall be applied and allowed to assume a partial set following which it shall be struck off flush with the adjoining surface. Patches shall be kept moist for several days to assure proper curing.
- E Top surface of slabs shall be screeded to the established grades and shall be a true plane with a tolerance of 1/8-in when checked with a 10-ft straightedge. The surface shall be finished to give a smooth, hard, even surface free from high or low spots or other defects. Concrete shall be given a broom finish. Failure to meet the condition shall be cause for removal, grinding, or other correction as directed by the Engineer.

### 3 08 SCHEDULE

- A The following (Table 2) are the general applications for the various concrete design strengths to be used.

TABLE 2

<u>Class</u>	<u>Design Strength (psi)</u>	<u>Description</u>
D	4,000	Slabs-on-grade and all structural concrete

END OF SECTION

## SECTION 16020

### ELECTRICAL

#### PART 1 GENERAL

##### 1 01 SCOPE OF WORK

- A Furnish all labor, materials, equipment and incidentals required to install complete and make operational, electrical systems as specified and as shown on the Drawings. The work specified in this Section is to be completed as part of the Government's time critical asbestos removal project in Libby, Montana, by the Government's removal contractor.
- B The work shall include the following:
  - 1 Confirm existing electrical service from the Power Company
  - 2 Disconnect the electrical connection to the existing bathroom
  - 3 Conduit, wire and field connections for all motors and control devices, and electrical equipment furnished under other Divisions
  - 4 Power wiring for all heating and ventilating equipment furnished under other Divisions, including power wiring for 120 Volt unit heater motors
- C Final locations of all electrical system components shall be coordinated with the Government and the property owner
- D The Government's removal contractor will be responsible for hiring a licensed electrical contractor to complete conduit installations, wiring, furnish and install electrical service and panelboards, and all other electrical work not included in this Section in conjunction with the construction of the restroom proposed for Building No. 2

##### 1 02 RELATED WORK

- A Excavation and backfilling, including gravel or sand bedding for underground electrical work is included in Division 2
- B Refer to the Architectural floor plans for room and building dimensions and exact locations of equipment other than electrical equipment

##### 1 03 SUBMITTALS

- A Submit shop drawings for equipment, materials, and other items furnished under this Section
- B The Government's check shall be for conformance with the design concept of the project and compliance with the Specifications and Drawings. Errors and omissions on approved shop drawings shall not relieve the Contractor from the responsibility of providing materials and workmanship required by the Specification and Drawings

- C All dimensions shall be field verified at the job site and coordinated with the work of all other trades
  - E Material shall not be ordered or shipped until the shop drawings have been approved No material shall be ordered or shop work started if shop drawings are marked "APPROVED AS NOTED CONFIRM " "APPROVED AS NOTED - RESUBMIT" or "NOT APPROVED "
- 1 04 CONTRACT PERFORMANCE REQUIREMENTS
- A Electric equipment, materials and installation shall comply with the latest edition of the National Electrical Code (NEC) and with the latest edition of the following codes and standards
    - 1 National Electrical Safety Code (NESC)
    - 2 Occupational Safety and Health Administration (OSHA)
    - 3 National Fire Protection Association (NFPA)
    - 4 National Electrical Manufacturers Association (NEMA)
    - 5 American National Standards Institute (ANSI)
    - 6 Insulated Cable Engineers Association (ICEA)
    - 7 Instrument Society of America (ISA)
    - 8 Underwriters Laboratories (UL)
    - 9 Factory Mutual (FM)
    - 10 National Electrical Testing Association (NETA)
  - B Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply
- 1 05 ENCLOSURE TYPES
- A Unless otherwise specified electrical enclosures shall have the following ratings
    - 1 NEMA 1 for dry, non-process indoor above grade locations
    - 2 NEMA 4 for outdoor locations and anything outside the bathroom
- 1 06 SERVICE AND METERING
- A The power company serving this project is Flathead Electrical Cooperative (FEC) Service will be obtained from an existing 240V, single phase distribution panel Voltage to be confirmed by FEC
- 1 07 CODES INSPECTION AND FEES



- A Equipment materials and installation shall comply with the requirements of the local authority having jurisdiction
- B Obtain all necessary permits and pay all fees required for permits and inspections

#### 1 08 TESTS AND SETTINGS

- A Test systems and equipment furnished under Division 16 and repair or replace all defective work and equipment Refer to the individual equipment sections for additional specific testing requirements
- B The following minimum tests and settings shall be performed
  - 1 Mechanical inspection, testing and settings of circuit breakers, disconnect switches motor starters overload relays, and equipment for proper operation
  - 2 Check the full load current draw of each motor Check ampere rating of thermal overloads for motors If incorrect thermal overloads are installed replace same with the correct size overload
  - 3 Check motor nameplates for correct phase and voltage Check bearings for proper lubrication
- C Furnish a typewritten report of all test results and final "As-Left" settings upon completion of testing

#### 1 09 RECORD DRAWINGS

- A As the work progresses, legibly record all field changes on a set of project contract drawings hereinafter called the "record drawings "
- B Record drawings shall accurately show the installed condition of the following items
  - 1 Raceways and pullboxes
  - 2 Conductor sizes and conduit fills
  - 3 Panel Schedule(s)
  - 4 Lighting Fixture Schedule(s)
  - 5 Lighting fixture, receptacle and switch outlet locations
  - 6 Underground raceway and duct bank routing

#### 1 10 MATERIALS AND EQUIPMENT

- A Materials and equipment shall be new

- B Material and equipment of the same type shall be the product of one manufacturer and shall be UL listed

## 1 12 EQUIPMENT IDENTIFICATION

- A Identify equipment (disconnect switches separately mounted motor starters, etc) furnished under Division 16 with the name of the equipment it serves
- B Nameplates shall be engraved, laminated plastic, not less than 1/16 in thick by 3/4 in by 2-1/2-in with 3/16-in high white letters on a black background
- C Nameplates shall be screw mounted to NEMA 1 enclosures Nameplates shall be bonded to all other enclosure types using an epoxy or similar permanent waterproof adhesive Two sided foam adhesive tape is not acceptable Where the equipment size does not have space for mounting a nameplate the nameplate shall be permanently fastened to the adjacent mounting surface

## 1 16 INTERPRETATION OF DRAWINGS

- A Unless specifically stated to the contrary, the Drawings are not intended to show exact locations of conduit runs Coordinate the conduit installation with other trades and the actual supplied equipment
- B Where circuits are shown as "home-runs" all necessary fittings and boxes shall be provided for a complete raceway installation Where home runs indicate conduit is to be installed concealed or exposed the entire branch circuit shall be installed in the same manner Unless otherwise indicated install branch circuit conduits exposed in process/industrial type spaces and concealed in finished spaces
- C Verify the exact locations and mounting heights of lighting fixtures, switches and receptacles prior to installation
- D Except where dimensions are shown, the locations of equipment, fixtures, outlets and similar devices shown on the Drawings are approximate only Exact locations shall be determined by the Contractor and approved by the Government during construction Obtain information relevant to the placing of electrical work and in case of any interference with other work proceed as directed by the Government and furnish all labor and materials necessary to complete the work in an approved manner
- E Circuit layouts are not intended to show the number of fittings, or other installation details Furnish all labor and materials necessary to install and place in satisfactory operation all power, lighting and other electrical systems shown
- F Redesign of electrical or mechanical work, which is required due to the Contractor's use of an alternate item arrangement of equipment and/or layout other than specified herein, shall be done by the Contractor at his/her own expense Redesign and detailed plans shall be submitted to the Government for approval No additional compensation will be provided for changes in the work, either his/her own or others, caused by such redesign

- G It is the intent of these Specifications that the Electrical Systems shall be suitable in every way for the service required. All materials and all work that may be implied as being incidental to the work of this Section shall be furnished at no additional cost to the Owner.
- H Raceways and conductors for lighting, switches, receptacles and other miscellaneous low voltage power and signal systems as specified are not shown on the Drawings. Raceways and conductors shall be provided as required for a complete and operating system. Homeruns, as shown on the Drawings, are to assist the Contractor in identifying raceways to be run exposed and raceways to be run concealed. Raceways shall be installed concealed in all finished spaces and may be installed exposed or concealed in all process spaces. Raceways installed exposed shall be near the ceiling or along walls of the areas through which they pass and shall be routed to avoid conflicts with HVAC ducts, doors, windows, etc. Raceways installed concealed shall be run in the center of concrete floor slabs, above suspended ceilings, or in partitions as required.

## PART 2 PRODUCTS

### 2.01 CONDUITS AND FITTING

#### A Rigid Steel Conduit

- 1 Rigid steel conduit interior and exterior shall be hot-dipped galvanized and be as manufactured by the Allied Tube and Conduit Corp., Wheatland Tube Co., Triangle PWC Inc. or equal.

#### B Rigid Nonmetallic Conduit

- 1 PVC conduit shall be rigid polyvinyl chloride schedule 40 and 80 as manufactured by Carlon, An Indian Head Co., Kraloy Products Co., Inc., Highland Plastics Inc. or equal.

#### C Liquidtight Flexible Metal Conduit, Couplings and Fittings

- 1 Liquidtight flexible metal conduit shall be Sealtite, Type UA, manufactured by the Anaconda Metal Hose Div., Anaconda American Brass Co., American Flexible Conduit Co., Inc., Universal Metal Hose Co. or equal.
- 2 Fittings used with liquidtight flexible metal conduit shall be of the screw-in type as manufactured by the Thomas & Betts Co., Crouse-Hinds Co. or equal.

#### D Boxes and Fittings

- 1 Pressed steel switch and outlet boxes shall be hot dipped galvanized as manufactured by the Raco Manufacturing Co., Adalet Co., O Z Manufacturing Co. or equal.
- 2 For use in NEMA 1 areas, terminal boxes, junction boxes, pull boxes etc, shall be galvanized sheet steel with continuously welded seams. Box bodies shall be flanged and shall not have holes or knockouts. Box bodies shall not be less than 14 gauge metal and covers shall not be less than 12 gauge metal. Covers shall be gasketed and fastened with stainless steel screws. Terminal boxes shall be furnished with hinged doors, terminal mounting straps and brackets. Terminal blocks shall be NEMA type, not less than 20

Amp 600 Volt Boxes shall be as manufactured by Hoffman Engineering Co , Lee Products Co , Keystone/Rees, Inc or equal

- 3 NEMA 4 terminal boxes, junction boxes pull boxes, etc, shall be sheet stainless steel unless otherwise shown on the Drawings Boxes shall have continuously welded seams and mounting feet Welds shall be ground smooth Boxes shall be flanged and shall not have holes or knockouts Box bodies shall not be less than 14 gauge metal and covers shall not be less than 12 gauge metal Covers shall be gasketed and fastened with stainless steel clamps Terminal boxes shall be furnished with hinged doors terminal mounting straps and brackets Terminal blocks shall be NEMA type, not less than 20 Amp, 600 Volt Boxes shall be as manufactured by Hoffman Engineering Co , Lee Products Co , Keystone/Rees, Inc or equal

E Wall and Floor Slab Opening Seals

- 1 Wall and floor slab openings shall be sealed with "FLAME-SAFE" as manufactured by the Thomas & Betts Corp , Pro Set Systems, Neer Mfg Co , Specified Technologies, Inc or equal

F Cold Galvanizing Compound

- 1 Cold galvanizing compound shall be as manufactured by ZRC Products Company, a division of Norfolk Corp or equal

2 02 WIRE, CABLE AND ACCESSORIES

- A Wires and cables shall be of annealed, 98 percent conductivity, soft drawn copper
- B All conductors shall be stranded, except that lighting and receptacle wiring may be solid
- C Except for control, signal and instrumentation circuits, wire smaller than No 12 AWG shall not be used
- D Wire for lighting, receptacles and other circuits not exceeding 150 Volts to ground shall be NEC Type THHN/THWN as manufactured by Okonite Co , Southwire Co , Pirelli Corp , or equal
- E Wire for control, status and alarm circuits shall be No 14 AWG NEC type THHN/THWN, stranded as manufactured by the Okonite Co , Carol Cable Co Inc West Pirelli Cable Corp or equal
- F Multi-conductor control and power cables shall have stranded conductors with type THHN/THWN insulated, nylon conductor covering, and an overall PVC jacket covering the individual wires Cable shall be TC rated meeting UL 1277 and IEEE 383 Standards Cable shall be flame resistant, nonpropagating and suitable for installation in a Class I, Division II hazardous location and for direct burial in earth Power and control cables shall be furnished with a green ground conductor Power cables shall be furnished with a white neutral conductor where required to serve phase to neutral loads Cable shall be as manufactured by the Okonite Co , Southwire Co , General Cable Co , or equal

- G Wire for process instrumentation signals (i.e. 1-5 VDC, 4-20 mA), RTD potentiometer and similar signals shall be

1 Single pair cable

Conductors	2 No 16 stranded and twisted on 2 in lay
Insulation	PVC with 300 Volt, 105 degree C rating
Shield	100 percent mylar tape with drain wire
Jacket	PVC with UL Subject 13, UL 1581, and manufacturers identification
Max overall diameter	0.262-in
Misc	UL listed for underground wet location use
Manufacturers	Belden No. 1030 or equal

- H Splices for power wiring shall be compression type connectors insulated with a heat shrink boot or outer covering and epoxy filling. Splice kits shall be as manufactured by Raychem, Ideal Industries, 3M Co. or equal.

- I Termination connectors for control wiring shall be of the locking fork-end (upturned leg ends) type as manufactured by Ideal Industries, 3M Co., Panduit Corp. or equal.

- J Splices for control wiring shall be insulated compression type connectors of the expanded vinyl insulated parallel or pigtail type as manufactured by Ideal Industries, 3M Co., Panduit Corp. or equal.

- K Wire markers shall be "Omni-Grip" as manufactured by the W. H. Brady Co., Thomas & Betts Co., 3M Co. or equal.

- L Direct buried cable warning tape shall be 6-in wide, red polyethylene not less than 0.0035 in thick. Tape shall be W. H. Brady Co. Cat. No. 91296 or equal.

2.03 WIRING DEVICES

- A Wall switches shall be heavy duty, specification grade, toggle action, flush mounting quiet type. All switches shall conform to the latest revision of Federal Specification WS 896. Wall switches shall be of the following types and manufacturer:

- 1 Single pole, 20 Amp, 120/277 Volt - Arrow-Hart, Catalog No. 1991, or equal by Harvey Hubbell, Inc., Pass & Seymour, Inc. or equal.
- 2 Double pole, 20 Amp, 120/277 Volt - Arrow-Hart, Catalog No. 1992 or equal by Harvey Hubbell, Inc., Pass & Seymour, Inc. or equal.

- B Receptacles shall be heavy duty, specification grade of the following types and manufacturer or equal. Receptacles shall conform to Federal Specification WC596-F.

- 1 Duplex, 20 Amp, 125 Volt, 2P, 3W - Arrow-Hart, Catalog No. 5362, or equal by Harvey Hubbell, Inc., Pass & Seymour, Inc.
- 2 Weatherproof/corrosion resistant duplex, 20 Amp, 125 Volt, 2P, 3W, with cover, Crouse-Hinds Co., Catalog No. WLRD-5-20 or equal by Appleton Electric.

- 3 Ground fault interrupter, duplex, 20 Amp, 125 Volt, 2P, 3W, GFCI feed thru type with 'test" and "reset" buttons Arrow Hart Catalog No GF5342 or equal by Harvey Hubbell, Inc , Pass & Seymour, Inc or equal

C Device Plates

- 1 Plates for indoor surface mounted device boxes shall be cast metal of the same material as the box, Crouse-Hinds, No DS23G and DS32G or equal
- 2 Device plates for switches mounted outdoors or indicated as weatherproof shall be gasketed, cast aluminum with provisions for padlocking switches 'On" and "Off," Crouse Hinds, No DS185, or equal
- 3 Weatherproof, gasketed cover for GFI receptacle mounted in a FS/FD box shall be Arrow-Hart, Catalog No 4501 FS or equal by Harvey Hubbell, Inc , Pass & Seymour, Inc or equal

2 04 MISCELLANEOUS EQUIPMENT

A Manual Motor Starters

- 1 Manual starters shall be suitable for the voltage and number of phase shown on the Drawings and shall be non reversing, reversing or two speed type as shown on the Drawings NEMA sizes shall be as required for the horsepower shown on the Drawings Manual starters shall have motor overload protection in each phase
- 2 Manual motor starters shall be as manufactured by the Square D Co or equal

B Circuit Breakers

- 1 Provide thermal magnetic circuit breaker in NEMA Type 12 Enclosure with externally operated handle Circuit breakers shall be fully rated for 22,000 Amps RMS symmetrical

C Polyethylene Warning Tape

- 1 Warning tape shall be red polyethylene film, 6 in minimum width
- 2 Warning tape shall be W H Brady Co , Catalog No 91296 or equal

2 05 PANELBOARDS

- A Panelboards shall be in accordance with the Underwriter Laboratories, Inc "Standard for Panelboards" and 'Standard for Cabinets and Boxes' and shall be so labeled where procedures exist Panelboards shall also comply with NEMA Standard for Panelboards and the National Electrical Code
- B Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply

C 120/240 Volt, single phase, 3 Wire panelboards shall be Type AQ as manufactured by the General Electric Company Type NQOD as manufactured by Square D Co Type Pow-R Line C as manufactured by Cutler-Hammer, or equal

D NEMA 4 and 12 panelboards shall be type DVP or DHP as required by voltage application, manufactured by the Crouse-Hinds Company or equal

E Rating

1 All panelboards shall be rated for the intended voltage

2 Circuit breaker panelboards shall be fully rated for the specified circuit breaker fault current interrupting capacity Series connected short circuit ratings will not be acceptable

F Buses

1 Bus bars for the mains shall be of copper Full size neutral bars shall be included Phase bussing shall be full height without reduction Cross connectors shall be copper

2 Neutral bussing shall have a suitable lug for each outgoing feeder requiring a neutral connection

3 Spaces for future circuit breakers shall be bussed for the maximum device that can be fitted into them

4 Equipment ground bars shall be furnished

G Circuit Breakers

1 Panelboards shall be equipped with circuit breakers

2 Circuit breakers shall be molded case, bolt-in type

3 Each circuit breaker used in 120/240 Volt panelboards shall have an interrupting capacity of not less than 22 000 amperes RMS symmetrical

4 Circuit breakers shall be as manufactured by the panelboard manufacturer

## 2 06 UNDERGROUND SYSTEM

A Excavation and backfilling, including gravel and sand bedding, are included in Division 2

B Concrete and reinforcing steel are included in Division 3

C Raceways shall be polyvinyl chloride conduit encased in concrete, except that rigid steel conduit shall be used for 600 Volt shielded wire and data highway wiring Refer to Section 16110 for material specification

D Handholes shall be precast concrete, heavy-duty type, designed for a Class H-20 wheel load and conform to ASTM C478 Precast units shall be as manufactured by Chase Precast Corp , American Precast Co or equal and constructed to dimensions as shown on the Drawings

- E Handhole frames and covers shall be cast iron heavy duty type for Class H-20 wheel loading

## 2 08 GROUNDING

- A Ground rods shall be 3/4-in by 10 ft copper clad steel and constructed in accordance with UL 467 The minimum copper thickness shall be 0.25 mm Ground rods shall be Copperweld or equal
- B Grounding conduit hubs shall be malleable iron type similar to Thomas & Betts Co , Cat No 3940 (3/4-in conduit size) by Burndy, O Z Gedney Co or equal, and of the correct size for the conduit
- C Buried grounding connections shall be by Cadweld process or equal exothermic welding system

## PART 3 EXECUTION

### 3 01 SLEEVES AND FORMS FOR OPENINGS

- A Provide and place all sleeves for conduits penetrating floors, walls, partitions, etc Locate all necessary slots for electrical work and form before concrete is poured
- B Exact locations are required for stubbing up and terminating concealed conduit Obtain shop drawings and templates from equipment vendors or other subcontractors and locate the concealed conduit before the floor slab is poured
- C Where setting drawings are not available in time to avoid delay in scheduled floor slab pours, the Government may allow the installations of such conduit to be exposed Requests for this deviation must be submitted in writing No additional compensation for such change will be allowed
- D Seal all openings, sleeves, penetration and slots

### 3 02 CUTTING AND PATCHING

- A Cutting and patching shall be done in a thoroughly workmanlike manner and be in compliance with modifications and repair to concrete as specified in Section [03740] Sawcut concrete and masonry prior to breaking out sections
- B Core drill holes in concrete floors and walls as required
- C Install work at such time as to require the minimum amount of cutting and patching
- D Do not cut joists, beams, girders, columns or any other structural members
- E Cut opening only large enough to allow easy installation of the conduit
- F Patching to be of the same kind and quality of material as was removed
- G The completed patching work shall restore the surface to its original appearance or better



- H Patching of waterproofed surfaces shall render the area of the patching completely waterproofed
- I Remove rubble and excess patching materials from the premises
- J When existing conduits are cut at the floor line of wall line, they shall be filled with grout of suitable patching material

### 3 03 INSTALLATION

- A Any work not installed according to the Drawings and Specification shall be subject to change as directed by the Government. No extra compensation will be allowed for making these changes
- B Electrical equipment shall be protected at all times against mechanical injury or damage by water. Electrical equipment shall not be stored outdoors. Electrical equipment shall be stored in dry permanent shelters. Do not install electrical equipment in its permanent location until structures are weather-tight. If any apparatus has been subject to possible injury by water, it shall be thoroughly dried out and tested as directed by the Government, or shall be replaced at no additional cost at the Government's discretion
- C Equipment that has been damaged shall be replaced or repaired by the equipment manufacturer at the Government's discretion
- D Coordinate the conduit installation with the Government, property owner, other trades and the actual supplied equipment
- E Install each circuit in separate conduit
- F Unless otherwise approved by the Government, conduit installed interior to the building shall be installed exposed, conduit installed exterior to the building shall be concealed
- G Verify the exact locations and mounting heights of lighting fixtures, switches and receptacles prior to installation
- H Exact locations of electrical equipment shall be determined by the Contractor, Government and property owner and approved by the Government during construction. Obtain information relevant to the placing of electrical work and in case of any interference with other work, proceed as directed by the Government and furnish all labor and materials necessary to complete the work in an approved manner

### 3 04 BOXES AND FITTINGS

- A Except where otherwise specified, all wiring shall be in rigid steel conduit
- B Rigid steel conduit shall be used for elbows and risers to equipment
- C All boxes shall be metal

- D Exposed switch, receptacle and lighting outlet boxes and conduit fittings shall be cast or malleable iron, except that cast aluminum shall be used with aluminum conduit
- E Concealed switch, receptacle and lighting outlet boxes shall be pressed steel
- F Terminal boxes, junction boxes and pull boxes shall have NEMA ratings suitable for the location in which they are installed
- G Conduit wall seals shall be used where underground conduits penetrate walls
- H Conduit sealing bushings shall be used to seal conduit ends exposed to the weather
- I No conduit smaller than 3/4 in electrical trade size shall be used nor shall any have more than the equivalent of three 90 degree bends in any one run Pull boxes shall be provided as required or directed
- J No wire shall be pulled until the conduit system is complete in all details
- K The ends of all conduits shall be tightly plugged to exclude dust and moisture during construction
- L All conduits shall be run at right angles to and parallel with the surrounding wall and shall conform to the form of the ceiling No diagonal runs will be allowed Bends in parallel conduit runs shall be concentric All conduit shall be run perfectly straight and true
- M Conduit terminating in pressed steel boxes shall have double locknuts and insulated bushings
- N Conduit terminating in NEMA 4 and 12 enclosures shall be terminated with Myers type conduit hubs
- O Conduits containing equipment grounding conductors and terminating in sheet steel boxes shall have insulated throat grounding bushings
- P Conduits shall be installed using threaded fittings
- Q Where conduits pass through openings in walls or floor slabs, the remaining openings shall be sealed against the passage of flame and smoke
- R Conduit ends exposed to the weather shall be sealed with conduit sealing bushings
- S All conduit which may under any circumstance contain liquids such as water, condensation, liquid chemicals, etc, shall be arranged to drain away from the equipment served If conduit drainage is not possible, conduit seals shall be used to plug the conduits
- T Where no type or size is indicated for junction boxes pull boxes or terminal cabinets they shall be sized in accordance with the requirements of N E C Article 370
- U Miscellaneous steel for the support of fixtures, boxes, transformers, starters contactors, panels and conduit shall be furnished and installed

- V Steel channels, flat iron and channel iron shall be furnished and installed for the support of all electrical equipment and devices, where required, including all anchors, inserts, bolts, nuts, washers etc for a rigid installation

### 3 05 WIRE CABLE AND ACCESSORIES

- A Uniquely identify all wires cables and each conductor of multi conductor cables (except lighting and receptacle wiring) at each end with wire and cable markers
- B Use lubrications to facilitate wire pulling Lubricants shall be UL approved for use with the insulation specified
- C All wire shall be color coded or coded using electrical tape in sizes where colored insulation is not available Where tape is used as the identification system, it shall be applied in all junction boxes and other accessible intermediate locations as well as at each termination
- D The following coding shall be used

<u>System</u>	<u>Wire</u>	<u>Color</u>
240/120 Volts	Neutral	White
1-Phase, 3-Wire	Line 1	Black
	Line 2	Red

- E Power conductors Terminations shall be die type or set screw type pressure connectors as specified Splices (where allowed) shall be die type compression connector and waterproof with heat shrink boot or epoxy filling Aluminum conductors (where specified) shall employ terminations and splices specifically designed for aluminum conductors
- F Control Conductors Termination on saddle-type terminals shall be wired directly with a maximum of two conductors Termination on screw type terminals shall be made with a maximum of two spade connectors Splices (where allowed) shall be made with insulated compression type connectors
- G Except where permitted by the Government no splices will be allowed in manholes, handholes or other below grade located boxes
- H Instrumentation cables shall be installed in rigid steel raceways as specified All circuits shall be installed as twisted pairs or triads In no case shall a circuit be made up using conductors from different pairs or triads Triads shall be used wherever three wire circuits are required
- I Terminal blocks shall be provided at all instrument cable junction, and all circuits shall be identified at such junctions
- J Test all 600 Volt wire insulation with a megohm meter after installation Make tests at not less than 500V Submit a written test report of the results to the Government

### 3 06 WIRING DEVICES

- A Switch and receptacles outlets shall be installed flush with the finished wall surfaces in areas with stud frame and gypboard construction, in dry areas with cement block construction or when raceways are concealed

- B Do not install flush mounted devices in areas designated DAMP WET or WET/CORROSIVE  
Provide surface mounted devices in these areas
- C Provide weatherproof devices covers in areas designated WET or WET/CORROSIVE

### 3 08 PANELBOARDS

- A Mount boxes for surface mounted panelboards so there is at least 1/2 in air space between the box and the wall
- B Connect panelboard branch circuit loads so that the load is distributed as equally as possible between the phase busses
- C Type circuit directories giving location and nature of load served Install circuit directories in each panelboard
- D Install markers on the front cover of all panelboards which identify the voltage rating  
Markers shall be made of self sticking B 500 vinyl cloth printed with black characters on an Alert Orange background, 2 1/4 in high by 9 in wide, Style A as manufactured by W H Brady Co or equal
- E Install a 1-in by 3-in laminated plastic nameplate with 1/4-in white letters on a black background on each panelboard Nameplate lettering shall be as shown on the Drawings  
Nameplates shall be stainless steel screw mounted

### 3 09 UNDERGROUND SYSTEM

- A Install raceways to drain away from buildings
- B Reinforce raceway banks when conduits pass over newly excavated pipes
- C The minimum cover for raceway banks shall be 24-in unless otherwise permitted by the Government
- D Swab all raceways clean before installing cable
- E Plug spare raceways and seal them watertight at all manholes buildings and structures
- F Seal the ends of raceways and make watertight at all handholes, buildings and structures

### 3 10 GROUNDING

- A Run grounding electrode conductors in rigid steel conduits Bond the protecting conduits to the grounding electrode conductors at both ends Do not allow water pipe connections to be painted If the connections are painted dis-assemble them and re-make them with new fittings
- B Install equipment grounding conductors with all feeders and branch circuits

- C Bond all steel building columns in new structures together with ground wire in rigid conduit and connect to the distribution equipment ground bus
- D Ground wire connections to structural steel columns shall be made with long barrel type one-hole heavy duty copper compression lugs bolted through 1/2 in maximum diameter holes drilled in the column web, with stainless steel hex head cap screws and nuts
- E Metal conduits stubbed into a motor control center shall be terminated with insulated grounding bushings and connect to the motor control center ground bus Bond boxes mounted below motor control centers to the motor control center ground bus Size the grounding wire in accordance with NEC Table 250.95, except that a minimum No. 12 AWG shall be used
- F Liquid tight flexible metal conduit in sizes 1 1/2-in and larger shall have bonding jumpers Bonding jumpers shall be external, run parallel (not spiraled) and fastened with plastic tie wraps
- G Ground transformer neutrals to the nearest available grounding electrode with a conductor sized in accordance with NEC Article 250-94
- H Seal exposed connections between different metals with No-Oxide Paint Grade A or equal
- I Lay all underground grounding conductors slack and, where exposed to mechanical injury, protect by pipes or other substantial guards If guards are iron pipe, or other magnetic material electrically connect conductors to both ends of the guard Make connections as specified herein
- J Care shall be taken to ensure good ground continuity, in particular between the conduit system and equipment frames and enclosures Where necessary, jumper wires shall be installed
- K All grounding type receptacles shall be grounded to the outlet boxes with a No. 12 THW green conductor connected to the ground terminal of the receptacle and fastened to the outlet box by means of a grounding screw
- L Test the grounding system Resistance to ground testing shall be performed during dry season Submit test results in the form of a graph showing the number of points measured (12 minimum) and the numerical resistance to ground
- M Testing shall be performed before energizing the distribution system
- N Notify the Government immediately if the resistance to ground for any building or system is greater than five ohms

END OF SECTION